REMARKS

The Office Action mailed March 10, 2003, has been received and reviewed. Claims 1 through 28, and 100 through 129 are currently pending in the application. Claims 1 through 28, and 100 through 129 stand rejected. Reconsideration is respectfully requested.

Information Disclosure Statement

Applicant notes the filing of an Information Disclosure Statement herein on February 11, 2003 and note that no copy of the PTO-1449 was returned with the outstanding Office Action. Applicant respectfully requests that the information cited on the PTO-1449 (which is the same as that of record to that date in the parent application hereto) be made of record herein.

Objection to the Specification

The amendment filed February 13, 2003 was objected to under 35 U.S.C. §132 for allegedly introducing new matter. Applicant respectfully traverses the objection.

It was stated that the phrase a conductive layer substantially "filling a remaining portion of the aperture" and at least one upper metal layer being "disposed within said aperture" as recited in claims 26 and 126 of the presently claimed invention was not supported by the as-filed specification. Applicant respectfully submits that claims 26 and 126 are supported at least by Fig. 8 and the corresponding discussion in the as-filed specification. Fig. 8 illustrates a conductive layer 64 in contact with said metal spacer 60, said conductive layer 64 substantially filling a remaining portion of the aperture and at least one upper metal layer 66 on the conductive layer 64 comprising Ti, Ta, W, Co or Mo or an alloy or a compound of any thereof, including TaN or TiN, said at least one upper metal layer 66 being disposed within said aperture laterally adjacent said metal spacer 60 and having an upper surface substantially coincident with an upper surface of said dielectric layer 54 and an uppermost extent of said metal spacer 60. Figure 8 is discussed in the as-filed specification, for example, page 14, lines 10-16 (with further reference to page 11, line 27 through page 14, line 28). As claims 26 and 126 are supported by the as-filed specification, reconsideration and withdrawal of the objection is requested.

35 U.S.C. § 112 Claim Rejections

Claims 17, 26 through 28, and 126 through 128 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Applicant respectfully traverses this rejection, as hereinafter set forth.

It was stated that the specification does not describe the metal layer comprising tantalum, titanium, tungsten, cobalt, molybdenum, or an alloy or a compound of any thereof, including TaN and TiN. Applicant respectfully submits that the specification provides "[p]referably, metal layer 52 is substantially similar to metal layer 8 described above and may be of any of the same metals, alloys of compounds". (Specification, page 12, lines 14-16.) The specification further provides several examples of suitable material for metal layer 8 including tantalum, titanium, tungsten, cobalt, molybdenum, or an alloy or a compound of any thereof, including TaN and TiN. (Specification, page 8, line 13 through page 9, line 16). Reconsideration and withdrawal of the rejection is requested.

Further, it was stated that the phrase a conductive layer substantially "filling a remaining portion of the aperture" and at least one upper metal layer being "disposed within said aperture" as recited in claim 26 and 126 of the presently claimed invention was not supported by the as-filed specification. Applicant respectfully submits that claims 26 and 126 are supported at least by Fig. 8 and the corresponding discussion in the as-filed specification. Fig. 8 illustrates a conductive layer 64 in contact with said metal spacer 60, said conductive layer 64 substantially filling a remaining portion of the aperture and at least one upper metal layer 66 on the conductive layer 64 comprising Ti, Ta, W, Co or Mo or an alloy or a compound of any thereof, including TaN or TiN, said at least one upper metal layer 66 being disposed within said aperture laterally adjacent said metal spacer 60 and having an upper surface substantially coincident with an upper surface of said dielectric layer 54 and an uppermost extent of said metal spacer 60. Figure 8 is discussed in the as-filed specification, for example, page 14, lines 10-16 (with further reference to page 11, line 27 through page 14, line 28). As claims 26 and 126 are supported by the as-filed specification, reconsideration and withdrawal of the objection is requested.

35 U.S.C. § 102(e) Anticipation Rejections

Anticipation Rejection Based on U.S. Patent No. 6,153,900 to Chang et al.

Claims 16, 23, 101, 116, 123 and 129 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Chang et al. (U.S. Patent No. 6,153,900). Applicant respectfully traverses this rejection, as hereinafter set forth.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Chang discloses a structure including a substrate 10 having a conductive layer 16 thereon. A first insulating layer 18 includes an aperture having spacers 22a that extend partially up the sidewalls of the aperture. The spacers 22a are in contact with a dielectric layer 22 and form a trench 14 within the aperture. The trench 14 also only partially fills with aperture and is filled with conductive material 24. First insulating layer 18 is in contact with conductive layer 24 which underlies a second insulating layer 26 and interconnect layer 28. The interconnect layer 28 also extends into the first insulating layer 18. (Chang, Fig. 6).

By way of contrast with Chang, independent claims 16 and 116 of the presently claimed invention include the similar recitation "a metal spacer abutting at least one sidewall of said at least one sidewall of the aperture and in contact with said dielectric layer, said metal spacer in contact with said underlying metal layer" and "a conductive layer in contact with said metal spacer, said conductive layer substantially filling a remaining portion of the aperture and having an upper surface substantially coincident with an upper surface of said dielectric layer".

Applicant respectfully submits that Chang fails to disclose, either expressly or inherently, every element of claims 16 and 116 of the presently claimed invention. Specifically, Chang fails to disclose "a conductive layer in contact with said metal spacer, said conductive layer substantially filling a remaining portion of the aperture and having an upper surface substantially coincident with an upper surface of said dielectric layer." Instead, Chang discloses dielectric

layer 22 filling a portion of an aperture and in contact with spacers 22a. Conductive layer 24 does not contact spacers 22a. Further, Chang discloses an interconnection layer 28 extending into first insulating layer 18. Thus, neither conductive layer 24 nor dielectric layer 22 comprise "an upper surface substantially coincident with an upper surface of said dielectric layer" as recited in claim 16 of the presently claimed invention. As Chang fails to disclose every element of claims 16 and 116 of the presently claimed invention, Chang does not anticipate claim 16 or claim 116. Accordingly, claims 16 and 116 are allowable.

Claims 17 through 25 and 101 are each allowable as depending, either directly or indirectly, from allowable claim 16.

Claims 117 through 125 and 129 are each allowable as depending, either directly or indirectly, from allowable claim 116.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on U.S. Patent No. 6,074,943 to Brennan et al. in view of U.S. Patent No. 6,277,745 to Liu et al.

Claims 1, 4 through 13 and 15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Brennan et al. (U.S. Patent No. 6,074,943) in view of Liu et al. (U.S. Patent No. 6,277,745). Applicant respectfully traverses this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

Brennan discloses a method of forming via structures using sidewalls as guides. Thus, as shown in FIG. 2H, Brennan discloses an Al-Cu layer 210 overlying an oxide layer 200 and an

optional TiN barrier layer 205. A layer of anti-reflective coating (TiN) 215 is deposited on the Al-Cu layer 210. A layer of sidewall material 240 is deposited (FIG. 2E) and etched to an etch stop layer 220. The etch stop layer 220 is removed and a dielectric material 250 is deposited over the structure in contact with and sidewalls 240. (FIG. 2G.) Brennan teaches that after the dielectric material 250 deposition is complete, "the sidewall material 240 will jut up into the ILD 250, forming sidewall extensions 260." (Brennan, col. 2, lines 64-66.) Subsequently, vias 270 are etched in the ILD layer 250 to contact the underlying interconnect. (FIG. 2H.)

Liu discloses a passivation method of post copper dry etching. Liu discloses a sandwich structure consisting of a bottom barrier layer 4, a copper layer 6 and a top barrier metal layer 8. After formation of this sandwich structure and patterning, the exposed sidewalls are passivated by means of a barrier metal spacer process. Liu teaches that the fully encapsulated copper lines are highly resistant to oxidation which is an otherwise inherent problem with bare copper lines. (Liu, Abstract)

By way of contrast with Brennan and Liu, claim 1 of the presently claimed invention recites a "metallization structure for a semiconductor device, comprising: a substrate comprising a substantially planar upper surface; and a conductive line for transmitting a signal laterally across said substrate, said conductive line comprising: a metal layer defining a pattern on a portion of the substrate upper surface; a single conducting layer overlying and substantially coextensive with the metal layer, said metal layer and said single conducting layer having substantially aligned sidewalls and said single conducting layer including an upper surface out of contact with any metal and defining an upper surface of said conductive line; and metal spacers flanking and extending at least substantially to a height of the sidewalls of the single conducting layer and metal layer".

Applicant respectfully submits that the combination of Brennan and Liu fails to teach or suggest every limitation of the presently claimed invention. Specifically, the proposed combination fails to teach or suggest a conductive line for transmitting a signal laterally across said substrate, said conductive line comprising "a single conducting layer overlying and substantially coextensive with the metal layer, said metal layer and said single conducting layer having substantially aligned sidewalls and said single conducting layer including an upper

surface out of contact with any metal and defining an upper surface of said conductive line" and "metal spacers flanking and extending at least substantially to a height of the sidewalls of the single conducting layer and metal layer". In contrast with claim 1 of the presently claimed invention, Brennan suggests metal contacting the upper layer. (Brennan, col. 7, lines 9-12). As stated, Liu teaches copper layer 6 underlying metal layer 8.

Further, no motivation exists to combine Brennan and Liu to include the bottom barrier layer of Liu to passivate the bottom surface of Brennan. Neither Brennan nor Liu provide any motivation or suggestion as to why such a passivation is necessary. Instead, Brennan merely states the desirability of thick buffer regions 320 to protect underlying layer 300. (Brennan, col. 1, lines 36-39).

As Brennan and Liu fail to teach or suggest every element of claim 1 of the presently claimed invention, applicant respectfully submits that Brennan in view of Liu fails to render claim 1 obvious. Accordingly, claim 1 of the presently claimed invention is allowable.

Claims 2 through 15 and 100 are each allowable as depending, either directly or indirectly, from allowable claim 1.

Obviousness Rejection Based on U.S. Patent No. 6,074,943 to Brennan et al. in view of U.S. Patent No. 6,277,745 to Liu et al. as applied to claims 1, 4-13 and 15 above, and further in view of U.S. Patent No. 6,166,439 to Cox

Claims 2, 3, 100, 102 through 113 and 115 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Brennan et al. (U.S. Patent No. 6,074,943) in view of Liu et al.(U.S. Patent No. 6,277,745) as applied to claims 1, 4 through 13 and 15 above, and further in view of Cox (U.S. Patent No. 6,166,439). Applicant respectfully traverses this rejection, as hereinafter set forth.

The discussion of Brennan and Liu above are incorporated herein. Cox discloses a low dielectric constant material and method of application to isolate conductive lines. Cox discloses a semiconductor device which includes a substrate and a conductive pattern formed on the

substrate. The conductive pattern includes at least two conductive lines adjacent one another. A low dielectric constant material is disposed between the at least two conductive lines. Cox fails to cure the deficiencies of Brennan in view of Liu.

With respect to dependent claims 2, 3 and 100, the Court of Appeals for the Federal Circuit has stated that "dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious." In re Fine, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). See also MPEP § 2143.03. Having failed to teach or suggest each and every limitation of the current application, the prior art referenced as rendering dependent claims 2, 3 and 100 obvious, cannot serve as a basis for rejection. As to claims 102 through 113 and 115, independent claim 102 includes similar claim elements to independent claim 1 of the presently claimed invention. Therefore, claim 102 and consequently, claims 103 through 113 and 115 are each allowable for the same reasons as set forth with respect to claim 1.

Obviousness Rejection Based on U.S. Patent No. 6,074,943 to Brennan et al. in view of U.S. Patent No. 6,277,745 to Liu et al. as applied to claims 1, 4-13 and 15 above, and further in view of U.S. Patent No. 6,046,502 to Matsuno

Claim 14 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Brennan et al. (U.S. Patent No. 6,074,943) in view of Liu et al.(U.S. Patent No. 6,277,745) as applied to claims 1, 4 through 13 and 15 above, and further in view of Matsuno (U.S. Patent No. 6,046,502). Applicant respectfully traverses this rejection, as hereinafter set forth.

The discussion of Brennan and Liu above are incorporated herein. Matsuno is directed toward a semiconductor device with improved adhesion between a titanium-based metal layer and an insulation film and fails to cure the deficiencies of Brennan. The Court of Appeals for the Federal Circuit has stated that "dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious." In re Fine, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). See also MPEP § 2143.03. Having failed to teach or suggest each and every limitation of the current application, the prior art referenced as rendering dependent claim 14 obvious, cannot serve as a basis for rejection.

Obviousness Rejection Based on U.S. Patent No. 6,153,900 to Chang et al. as applied to claims 16, 23, 116 and 123 above, and further in view of U.S. Patent No. 5,712,195 to Chang

Claims 17, 18, 24, 25, 117, 118, 124 and 125 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. (U.S. Patent No. 6,153,900) as applied to claims 16, 23, 116 and 123 above, and further in view of Chang (U.S. Patent No. 5,712,195). Applicant respectfully traverses this rejection, as hereinafter set forth.

The Court of Appeals for the Federal Circuit has stated that "dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious." In re Fine, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). See also MPEP § 2143.03. Having failed to teach or suggest each and every limitation of the current application, the prior art referenced as rendering dependent claims 17, 18, 24, 25, 117, 118, 124 and 125 obvious, cannot serve as a basis for rejection.

Obviousness Rejection Based on U.S. Patent No. 6,153,900 to Chang et al. as applied to claims 16, 23, 101, 116, 123 and 129 above, and further in view of U.S. Patent No. 6,242,340 to Lee

Claims 19, 20, 119 and 120 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. (U.S. Patent No. 6,153,900) as applied to claims 16, 23, 101, 116, 123 and 129 above, and further in view of Lee (U.S. Patent No. 6,242,340). Applicant respectfully traverses this rejection, as hereinafter set forth.

The discussion of Chang is incorporated herein. Lee fails to cure the deficiencies of Chang. Lee discloses a method of forming an interconnect layer wherein the interconnect layer comprises a substrate 20 having a dielectric layer 22 thereon. The dielectric layer 22 includes a trench filled with a conducting metal (first interconnect) 28. An insulation layer 30 overlays the first interconnect 28 and underlies a second dielectric layer 32. A second trench is formed in the second dielectric layer 32. The trench includes spacers 36a that extend to insulating layer 30 and is filled with a second conducting metal. 40. (Lee, FIGs. 3A-3F and col. 3-4, lines 60-67).

The Court of Appeals for the Federal Circuit has stated that "dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious." In re Fine, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). See also MPEP § 2143.03.

Having failed to teach or suggest each and every limitation of the current application, the prior art referenced as rendering dependent claims 19, 20, 119 and 120 obvious, cannot serve as a basis for rejection.

Obviousness Rejection Based on U.S. Patent No. 6,153,900 to Chang et al. as applied to claims 16, 23, 101, 116, 123 and 129 above, and further in view of U.S. Patent No. 6,166,439 to Cox

Claims 21, 22, 121 and 122 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. (U.S. Patent No. 6,153,900) as applied to claims 16, 23, 101, 116, 123 and 129 above, and further in view of Cox (U.S. Patent No. 6,166,439). Applicant respectfully traverses this rejection, as hereinafter set forth.

The Court of Appeals for the Federal Circuit has stated that "dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious." In re Fine, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). See also MPEP § 2143.03. Having failed to teach or suggest each and every limitation of the current application, the prior art referenced as rendering dependent claims 21, 22, 121 and 122 obvious, cannot serve as a basis for rejection.

Obviousness Rejection Based on U.S. Patent No. 6,153,900 to Chang et al. as applied to claims 16, 23, 101, 116, 123 and 129 above, and further in view of U.S. Patent No. 6,054,380 to Naik

Claims 26 through 28, and 126 through 128 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. (U.S. Patent No. 6,153,900) as applied to claims 16, 23, 101, 116, 123 and 129 above, and further in view of Naik (U.S. Patent No. 6,054,380). Applicant respectfully traverses this rejection, as hereinafter set forth.

The discussion of Chang above is incorporated herein. Naik discloses an apparatus for protecting a metal interconnect from corrosion due to contact with a low dielectric material. A substrate 300 includes metal lines 302 flanked by spacers 306 extending above the metal lines 302. A low dielectric constant material 310 flanks the spacers 306 and a PETOS layer 316 is on

the low dielectric constant material 310. A titantium layer 318 is on the PETOS layer 316 and extends into an aperture therein. The titantium layer 318 extends into the low dielectric constant material 310 and contacts the metal lines 302 and spacers.

By way of contrast with Chang and Naik, claims 26 and 126 of the presently claimed invention include the similar recitation of "a metallization structure for a semiconductor device, comprising a conductive layer in contact with said metal spacer, said conductive layer substantially filling a remaining portion of the aperture" and "at least one upper metal layer on the conductive layer comprising Ti, Ta, W, Co or Mo or an alloy or a compound of any thereof, including TaN or TiN, said at least one upper metal layer being disposed within said aperture laterally adjacent said metal spacer and having an upper surface substantially coincident with an upper surface of said dielectric layer and an uppermost extent of said metal spacer".

Applicant respectfully submits that Chang in view of Naik fails to teach or suggest every element of claims 26 and 126 of the presently claimed invention. Instead, Chang discloses dielectric layer 22 filling a portion of an aperture and in contact with spacers 22a. Conductive layer 24 is not in contact with spacers 22a. Further, Chang discloses an interconnection layer 28 extending into first insulating layer 18 and extending laterally beyond the spacers 22. However, interconnection layer 28 extends beyond first insulating layer 18 and into conductive layer 24 and does not have an upper surface "substantially coincident with an upper surface of said dielectric layer and an uppermost extent of said metal spacer" as recited in claims 26 and 126 of the presently claimed invention. Similarly, Naik discloses metal lines 302 having a titantium layer 318 thereon which extends above low dielectric layer 310, above spacers and flanking sidewalls and upper surface of PETOS layer 316.

As Chang and Naik fail to teach or suggest every element of claims 26 and 126 of the presently claimed invention, the references do not render claims 26 and 126 obvious. Accordingly, claims 26 and 126 are allowable.

Claims 27 and 28 are each allowable as depending, either directly or indirectly, from allowable claim 26.

Claims 127 and 128 are each allowable as depending, either directly or indirectly, from allowable claim 126.

Obviousness Rejection Based on U.S. Patent No. 6,074,943 to Brennan et al. in view of U.S. Patent No. 6,277,745 to Liu et al. in view of U.S. Patent No. 6,166,439 to Cox as applied to claims 2, 3, 100, 102-113 and 115 above, and further in view of U.S. Patent No. 6,046,502 to Matsuno

Claim 114 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Brennan et al. (U.S. Patent No. 6,074,943) in view of Liu et al.(U.S. Patent No. 6,277,745) in view of Cox (U.S. Patent No. 6,166,439) as applied to claims 2, 3, 100, 102 through 113 and 115 above, and further in view of Matsuno (U.S. Patent No. 6,046,502). Applicant respectfully traverses this rejection, as hereinafter set forth.

The Court of Appeals for the Federal Circuit has stated that "dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious." In re Fine, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). See also MPEP § 2143.03. Having failed to teach or suggest each and every limitation of the current application, the prior art referenced as rendering dependent claim 114 obvious, cannot serve as a basis for rejection.

CONCLUSION

Claims 1-28 and 100-129 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, he is respectfully invited to contact Applicant's undersigned attorney.

Respectfully submitted,

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